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APCBEE Procedia 5 (2013) 22 – 26

Procedia APCBEE

www.elsevier.com/locate/procedia

ICESD 2013: January 19-20, Dubai, UAE

Developing a Framework for Study of GSCM Criteria in Indian Mining Industries

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Abstract

Growing awareness of environmental protection has triggered development of Green Supply Chain Management (GSCM). In order to maintain a competitive edge different industrial sectors including mining are showing their inclination to adopt GSCM as an integral part of their business strategy. Various criteria and sub-criteria of effective GSCM implementation are identified from literature. This paper used analytical hierarchy process (AHP) approach to develop an analytical frame work that would facilitate the study of these criteria and sub-criteria. The framework tried to integrate various perspectives of GSCM and represented them in a hierarchical structure on priority basis. This hierarchical structure may provide a procedural guidance to organizations in effective GSCM implementation.

Keywords: GSCM; AHP; Mining Industries;GSCM Criteria; Sub-criteria; Literature Survey.

1. Introduction

Mining industries are increasingly adopting GSCM implementation as one of the strategic point for obtaining social license to operate and attract financial institutions. GSCM has been evolved as a separate field by integrating environmental concepts with the concepts of traditional supply chain management [1]. It aims at reduction of energy and material usage as well as elimination or minimization of waste production by each and every stage of supply chain.

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doi:10.1016/j.apcbee.2013.05.005

The GSCM issue is significant for mining industries because recent studies have shown that use of primitive extraction techniques in Indian mines due to lack of appropriate technology, incompetent human resources, reluctance to plan and disregard towards environmental issues have led to a number of environmental threats in addition to wasteful mining and poor mineral recovery. Mining and allied industries are confronted with the challenge of having to control a wide range of potentially serious environmental problems such as acid mine drainage (AMD), chronic soil erosion, tailings contamination, and heavy metals overloading [2],[3]. With the increasing public awareness regarding mining environmental issues, the common problem of these mining industries is that they suffer from public as well as government pressures for green process. In this context this research assumes its importance by identifying critical factors (criteria) for effectiveness of GSCM implementation in Indian mining industries.

2. Literature Review

Presently literature on GSCM criteria is scarce and as GSCM philosophy is in parallel with or, overlaps with some other well known management programs like cleaner production (CP), environmental management system (EMS) [4] and total quality management (TQM)[5], therefore literature on EMS, CP and TQM has been reviewed to identify the critical success factors for TQM, EMS and CP as these factors may hold the key to the effectiveness of GSCM.

Organizing, systems and technologies, assessment and feedback and training and people are identified as critical decision criteria for effective CP implementation in PWB and PCB manufacturers in Taiwan [6], [7]. Another study by Sambasivan and Fei [8] on Malaysian manufacturing industries had identified management approach, organizational change, external and social aspects and technical aspects as four major criteria for success of ISO-14001 based EMS implementation. They have also identified fourteen sub-criteria of the above four criteria and represented them in a hierarchical structure on priority basis using AHP. Daily and Huang [5] identified policy, planning, implementation and operation, checking and corrective action and management review as the key categories of EMS criteria. Another study by Zutshi and Sohal [10] on success factors for EMS adoption and maintenance proposed management leadership and support, learning and training, internal analysis and sustainability as the major decision criteria for efficient EMS implementation.

Lewis et al. [9] identified Top management commitment, gap analysis, system deployment and continual improvement as the four major criteria for effective TQM implementation. They also identified fifteen sub-criteria and fifty four components of these sub-criteria those having significant impact on effectiveness of TQM implementation. The following table summarizes various criteria for effective GSCM implementation

Table 1. GSCM criteria

Criteria No.	Criteria	Reference
A11.	Commitment to Continual Improvement and Pollution Prevention	[5]
A12.	Commitment to Comply with Legislation	[5]
A13.	Framework for Setting and Reviewing Environmental Goals	[5]
A14.	Commitment to Documentation and Implementation	[5]
A21.	Legal and Other Requirements (LOR)	[5]
A22	Environmental Objectives and Targets (EOT)	[5], [10]
A23	Environmental Aspects Determination (EAD)	[5]
A24.	Structure of the Environmental Management Program (SEMP)	[5]
A31	Environmental Education and Training(EET)	[10],[7]
A32.	Workforce Development Activities(WKDA)	[9]
A33.	Employee Reward and Recognition Scheme	[9]
A41.	Management Involvement(MINV)	[9],[10]
A42.	Employee Involvement(EINV)	[9],[7]
A43.	Managing Organisational Change	[7]

A44.	Green Teamwork	[9]
B11	Strength of Current Process	[7]
B12.	Shortcomings of Current Process	[7]
B13	Best Practices	[7]
B14	Cross functional	[9]
B21.	Availability of Monitoring and Measuring equipment	[8]
B22.	Availability of Assistance from Environmental Specialist	[8]
B23.	Feasibility of Production Process Enhancement	[8]
B24.	Risk Analysis	[10]
B31.	Identification of Culture	[9]
B32.	Alignment of Culture with Environmental Program	[9]
B33	Monitoring Culture Change	[9],[10]
B41.	Quantity of Energy used at Each Stage	[7],[10]
B42.	Quantity of Material Usage at Each Stage	[7],[10]
B43.	Quantity of Waste Released at Each Stage	[7],[10]
C11.	Development of EMS Organizational Structure	[13]
C12.	Documentation of Organizational Chart	[13]
C13.	Routing to all Relevant Employees	[13]
C14	Defining All EMS Position Responsibilities	[13]
C21.	Communication Between Involving Departments	[10]
C22.	Between Top Management and Employees	[10]
C23.	Between Organization and its Supply Chain Partners	[10]
C31.	Updating Documents	[10],[5]
C32	Locating Documents	[10],[5]
C33	Discarding Obsolete Documents	[10],[5]
C34.	Integration of Documentation System	[10]
C41.	Identification Key Activities Requiring Control	[10]
C42	Establishment of Operational Control Requirements of Key Activities	[10],[5]
C43.	Identification of Specific Portion of Procedure Requiring Attention	[13]
C44.	Review of Monitoring Results Against Requirements	[13]
C51.	Systems to Identify and Respond to Accidents	[8]
C52.	Procedures for Preventing and Mitigating Environmental Impact	[8]
C53.	Periodical Review of Emergency Systems	[8]
D11.	Calibration of Monitoring Tools	[13]
D12.	Maintenance of Monitoring Equipments	[13]
D21.	Process Performance	[13]
D22.	Process Reliability	[13]
D23.	Process Conformance	[13]
D31.	Records Should be Comprehensive	[5]
D32.	Specialized	[5]
D33.	Traceable	[5]
D34.	Retrievable and Damage Protected	[5]
D41.	External Audit	[10]
D42.	Internal Audit	[10]
D43.	Independent Audit	[13]
D51.	Review Environmental Potentialities of Organizational activities	[13]
D52.	Review of Extent of Non-conformance to EMS Standards	[13]
D53	Review of Effectiveness of Corrective Action	[13]
D54	Review of Adequacy of Resources	[13]

3. Methodology

In Indian mining context GSCM is at its nascent stage and only few big companies have implemented GSCM practices. The study therefore used an analytical approach such as AHP to study various criteria for effectiveness of GSCM instead of statistical approach that depends upon bigger sample sizes. The AHP methodology was used mainly because of its ability to decompose a complex problem into a multilevel hierarchical structure of criteria and sub-criteria [9]. AHP developed by Saaty (1970), is a simple mathematical method based on elementary operations with matrices. It has the ability to accommodate

qualitative attributes in an organized manner and can be used to structure a system and its environment into mutually interacting elements and then to synthesize them by measuring and ranking the impact of these elements on the entire system [8]. With the objective or goal (effectiveness of GSCM implementation) occupying position at the top level of the hierarchy, various criteria and sub-criteria occupy positions in the subsequent levels.

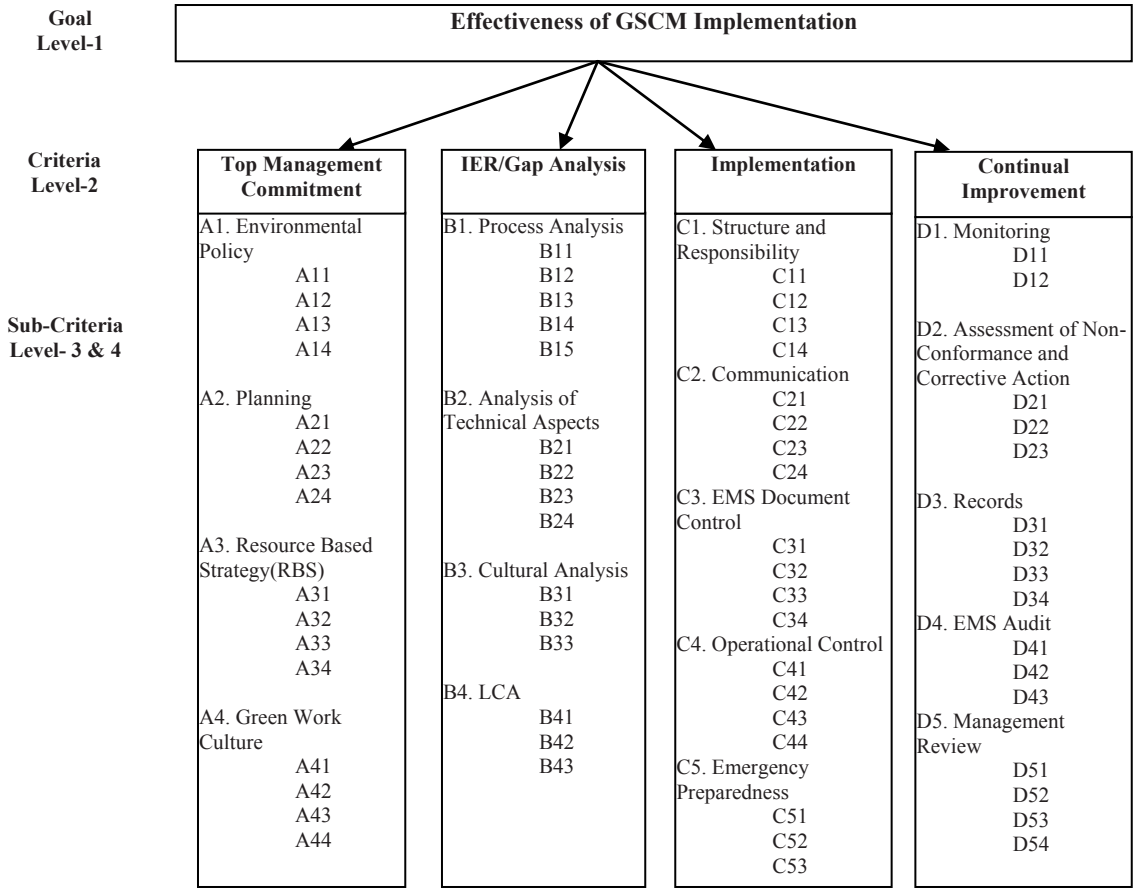

Fig. 1. Hierarchical model for the selection of GSCM implementation criteria on priority basis

4. Discussion and Managerial Implication

Incorporating a literature review eighteen criteria and sixty-six sub-criteria having significant impact on effectiveness of GSCM was identified. These criteria were further categorized under 4 major criteria. An analytical framework using AHP was developed that structured these criteria into a hierarchy for facilitating the conduct of the study. The hierarchical structure decomposes the goal (occupying highest position in the hierarchy) into various criteria, sub-criteria and elements in successive levels as shown in Fig 1. The advantages that can be obtained by managers and decision makers from the proposed frame work are as follows.

- The hierarchical representation of the GSCM selection problem can allow the decision-makers to easily observe the effect of the changes of the priority in the upper levels on the priority of criteria at the lower levels [9].
- The analysis can help the managers or decision makers to structure their problem with its differing aspects rather than only focusing on one or two aspects.

5. Conclusion

The implementation of GSCM is a complex and difficult phenomena. Complexity of GSCM implementation is due to its dependency on several criteria and sub-criteria. For effective GSCM implementation all the relevant criteria has to be identified and the existing interrelationship between them has to be understood. This paper has made an attempt to identify various success criteria for GSCM implementation in Indian mining industries and used AHP approach to represent the existing interrelationship between them in a structured way. The model developed can be used by other organizations to serve their specific needs basing upon the circumstances.

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